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Preliminary Analysis of Multi-Impactor Strategy for Planetary Defense

Potentially hazardous asteroids pose a small, but not negligible, risk of impact towards Earth. This work focuses on the kinetic impactor method for mitigating that risk. A single kinetic impactor has been successfully tested, but this method has its limitations. These include not being able to adjust the trajectory of the asteroid after impact. This work proposes several smaller impactors, applied in succession to the target asteroid, instead. Methods – Through the use of a computer model of our solar system, including the planets, moons, and four largest asteroids, as well as our target asteroid, we simulated impacts as changes to the velocity of a target asteroid. In this work, the number of impactors and the time spacing between them was varied.

The data gathered from the model showed that separating a single kinetic impactor into several smaller impactors does affect the trajectory of the target asteroid. In most scenarios investigated, splitting the single impactor into several smaller impactors had a negative effect, but in the scenario where four impactors, spaced at 1.1 years apart, were applied to the target asteroid, we found better results than the single impactor scenario.

We have shown that taking a single kinetic impactor and splitting it into several smaller impactors has an effect on the orbit of a target asteroid. Our results show that the four impactors (spaced 1.1 years apart) produce 200,000 km greater deviation in orbit than the single kinetic impactor scenario. The multi-impactor strategy requires further study, but this initial analysis shows promise. Relevance – This method is an improvement on an existing method for planetary defense, which is the kinetic impactor. Multi-impactor missions should allow for decreased damage to the target asteroid, mid-mission analysis of the asteroid's structure and composition, and mid-mission trajectory corrections if the first impactor, for whatever reason, does not produce the desired result. The multi-impactor strategy improves our ability to defend ourselves from asteroid threats to Earth.